REMARKS

In the Office Action, the Examiner indicated that claims 1 through 20 are pending in the application and the Examiner rejected all claims.

The Claim Objections

On page 3 of the Office Action, the Examiner objected to claims 7 and 14 for not further limiting the subject matter of the preceding claim. Applicant respectfully traverses this objection. Claim 7 does, indeed, further limit the subject matter of claim 1. Step 2 of claim 1 does generate an optimized rule and the optimized rule is stored in an optimized rule storage area. This process is repeated, as claimed in claim 7, so that each time one of these rules is developed, it is stored as part of the optimized rule set, which can contain (and preferably does contain) plural rules. As a result of the process of claim 7, a new rule is generated and added to the optimized rule set. Accordingly, claim 7 (and claim 14) further limit the claims from which they depend. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the objection to claims 7 and 14.

The Rejections under 35 U.S.C. §§102 and 103

The Present Invention

The present invention relates to a fuzzy logic system with evolutionary variable rules. According to the present invention, the features, qualifiers, and operators of rules, and the rules themselves, are continually generated and evolved using **genetic algorithms**, based on real-time data. This invention is especially useful in stock market forecasting and, in particular, day-trading wherein the pertinent data may change many times over a

short period of time.

First, a random set of rules (a population of chromosomes) is generated using a random selection from each of the categories of operators, features, cases, and qualifiers. Next, the population of chromosomes are evolved to improve their fitness function in a known manner. The fitness function is a cost function that penalizes the algorithm if it renders non-compliant results, i.e., results that do not logically follow the trend of the input data.

Once the fitness function **plateaus** for the population (i.e., **ceases to improve**) the resultant rule (a chromosome) is stored, e.g., in a bin, thereby creating a storage location or "binning pool" in which "optimized" rules are accumulated. The chromosomes then go through further generation (initialization) and evolution to improve their overall fitness function. The chromosomes that are subjected to this further evolution may be a set of newly generated chromosomes (including chromosome(s) from the previous evolutionary session). This process is repeated until adding more chromosomes to the optimized rule pool does not improve the overall fitness of the pool. At this point the algorithm may be stopped and the best chromosomes then define the rules of the system. For example, if it is presumed that a optimized chromosome pool population can contain 15 chromosomes, then once 16 chromosomes have been established, an evaluation is made and the 15 fittest chromosomes are kept while the worst of the 16 is deleted.

Thus, the fuzzy logic system of the present invention creates fuzzy rules in real-time and updates the fuzzy rules dynamically. This is accomplished by using **genetic algorithms** to continually optimize the features, qualifiers, cases, and operators of the fuzzy rules until they **plateau**. The fuzzy logic system may be utilized in applications

requiring constantly-updated fuzzy rules and also in applications where fuzzy rules are difficult to pre-define due to a large quantity of input data, such as, for example, stock market forecasting.'

The Hung Reference (U.S. Patent No. 5,727,130)

Hung teaches a genetic algorithm for constructing and tuning a fuzzy logic system. More specifically, Hung deals with an optical character recognition (OCR) application, whereby training sets of optimized moment and variant character data are used to evaluate fuzzy logic systems modeled with parameters produced through the use of a genetic algorithm. The fuzzy logic systems are evaluated and given a score to input back into the genetic algorithm, which uses the score in a reproduction process to produce new chromosomes for reinsertion into the fuzzy logic system models. Of relevance to the present invention is the fact that the chromosomes are evaluated to determine their performance within a model of the fuzzy logic system to be developed. The evaluation process includes a comparison to a threshold value which, if met, terminates the process.

The Chidambaran et al. Reference

Chidambaran et al. teach the use of genetic programming to create a computer program that approximates the relationship between the price of a stock option, the terms of the option contract, and the properties of the underlying stock price that forms the basis for the stock option. Using genetic programming, the authors of the Chidambaran et al. reference claim that they can create a computer program that achieves a better solution to the problem (approximating the relationship between the option price, the option contract

and the underlying stock price) than the "Black-Scholes" option pricing model, a widely accepted option pricing theory used in financial markets at the time of the writing of the Chidambaran et al. reference. In accordance with Chidambaran et al., the steps of the evolutionary program are repeated for a "pre-specified number of times" and then the steps are terminated.

Rejections under 35 U.S.C. §102

The hybridizing of fuzzy logic and genetic algorithms is the topic of textbook explanation and neither Hung nor the present invention can claim such broad concepts as being within the scope of their respective inventions. Hung uses such hybridized elements for the specific problem of optical character recognition (OCR).

The present claims are directed specifically to the derivation and generation of an optimized rule set for a fuzzy logic system. As described in the present application, these have specific application in the field of market prediction. Most importantly, Hung is devoid of any teaching or suggestion of continuing of the evolutionary process until the fitness function of the rules cannot be further improved, i.e., become substantially constant, indicating that it has reached a plateau.

The Examiner asserts that column 4, lines 27-67 through column 5, lines 1-8 teaches the evolving of random rules using a genetic algorithm to improve their fitness function until the overall fitness function of the rules plateaus. However, it is clear from reading these cited sections that, contrary to the assertion of the Examiner, plateauing is not taught or suggested by Hung. Specifically, Hung teaches the setting of a threshold value and determination of the process when the threshold is met. In other words, a target

value is preset ahead of time, and when the target value is reached, the process is completed. By contrast, the present invention, as specifically claimed in both independent claims 1 and 9, involves the continuing of the evolutionary process, not for a fixed, predetermined number of generations, nor until a fixed, predetermined value is reached, but instead, it continues until the fitness function of the rules cannot be further improved, i.e., becomes substantially constant, indicating the reaching of the plateau. As an example of the differences, it is conceivable that using the Hung process, the threshold level will be reached after a single evolutionary process step, and that if additional evolutionary process steps were performed, additional improvement would occur. However, since Hung relies upon a threshold level, these additional improvements will never be realized.

By contrast, by focusing on plateauing, as is done in the present invention, the process proceeds until there is no apparent value to continuing. This is significantly different from the Hung reference and results in the potential for much improved results. These elements are specifically claimed in the present invention, and thus all of the claims are allowable over Hung.

The §103 Rejections

The addition of Chidambaran does not teach or suggest the plateauing evolution process claimed in each of the independent claims herein. Without such teaching or suggestion, it is improper to reject the claims based upon the proposed Huang/Chidambaran combination proposed by the Examiner. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the rejection of claims 9-20 under 35 U.S.C. §103.

Conclusion

Applicant has presented, in this response and in the response filed on July 29, 2002, and in the Appeal Brief filed on June 25, 2003, sufficient reasons why the present invention patentably defines over the Chidambaran and Hung references, either alone or in combination.

The present invention is not taught or suggested by the prior art. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the rejection of the claims. An early Notice of Allowance is earnestly solicited.

The Commissioner is hereby authorized to charge any fees associated with this communication to Deposit Account No. 19-5425.

Respectfully submitted,

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Date

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